

COASTAL HERITAGE

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Island Science
Special Ecosystems
Lure Researchers



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PHOTO/GRACE BEAHM ALFORD



S.C. SEA GRANT CONSORTIUM
Coastal Science Serving South Carolina

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ACTIVE NEST. Brown pelicans, royal terns, and laughing gulls dominate Deveau Bank, thriving there in part because the island is off-limits to people.
PHOTO/GRACE BEAHM ALFORD

Island Science

Special Ecosystems Lure Researchers

by Joey Holleman

The view to the south from atop the substantial sand dunes at the northern tip of Waties Island is stunning and educational. Nary a human soul walks the 2.5-mile beach or tromps through the wide dune field of the undeveloped barrier island.

Across a narrow, constantly shifting inlet to the south, the hotels of North Myrtle Beach toss afternoon shadows on flocks of sunbathing vacationers.

Most people experience the South Carolina coast on vacations spent in places like North Myrtle Beach, where they often walk directly off the hot summer sand into a hotel or house. For a small subset of the population, however, late spring and summer marks the time to head to the state's undeveloped

barrier islands. Field season for research scientists means steering boats through winding tidal creeks, bush-whacking through thick maritime forests, and driving all-terrain vehicles (ATVs) up and down beaches marked with more turtle tracks than footprints.

Despite a lack of facilities and an abundance of biting insects, undeveloped barrier islands represent nirvana for researchers. They can study natural ecosystems with little direct impact from humans – gauging wind energy potential without buildings to affect the breeze, tracking sea turtle genetics without curious beachcombers bothering nests, installing trail cameras at alligator nests without fear the expensive equipment might be stolen.

Fortunately, undeveloped barrier

islands and beaches are common along the South Carolina coast. Twenty-one of the 34 barrier islands on the South Carolina coast are either undeveloped or have just a handful of structures. The state's developed sandy beaches stretch out for 98 miles, which is slightly more than the 89 miles of undeveloped beaches, according to a report titled "The Physical Condition of South Carolina Beaches 1980-2010."

As that work in the *Journal of Coastal Research* indicates, barrier islands are extremely dynamic. In fact, the linear distance of sandy beaches is constantly in flux, not so much because people are constructing new beachfront buildings but because barrier islands naturally move.

Meanwhile, similar dynamics can

WHERE SEA MEETS LAND

Of South Carolina's 34 barrier islands, 21 have little or no residential development.



What is a barrier island?

Barrier islands have active beaches and are bordered on the other sides by creeks, rivers, or marshes. Islands without active beaches, such as St. Helena and Wadmalaw, are sea islands.

MAP/CRYSTAL NARAYANA/S.C. SEA GRANT CONSORTIUM

factor into a rise in the actual number of undeveloped barrier islands. For instance, Cape Island in the Cape Romain National Wildlife Refuge split at least temporarily into three separate islands when tropical storms or hurricanes in the past decade created new inlets in the skinny strip of land. Also, just south of Winyah Bay in one of the few regions on the S.C. coast where barrier islands are building up rather

than eroding, what once was not much more than a sand bar is now known by its government caretakers as Sand Island. Not on most maps yet, it features the four geographic attributes of a barrier island:

- active sandy beach,
- vegetated high ground,
- water on all four sides, and
- salt marsh attached to the back side.

Sand Island used to be a sand

bank, the most ephemeral of coastal land masses, typically with minimal or no vegetated high ground or attached marsh. Sand banks represent an important subset of coastal research because several threatened bird species almost exclusively breed and nest on them. The S.C. Department of Natural Resources (SCDNR) manages most of the sand banks and either restricts or bans human activity on

them to protect nesting birds. However, researchers studying brown pelicans have been allowed access in recent summers to four of the most prominent S.C. sand banks – Deveaux Bank off Seabrook Island, Bird Key Stono off Folly Island, and Crab Bank and Castle Pinckney in Charleston Harbor.

Like all scientists who spend time on the state's undeveloped islands, they appreciate the locale as they gather data. "We're fortunate that we get to spend time on these islands, and it is not something I take lightly," says Patrick Jodice, a professor in Clemson University's Forestry and Environmental Conservation Department who heads up the pelican project. "There are few places you can do work like this."

ISLANDS HAVE LURED SCIENTISTS FOR CENTURIES

Documented research on the state's barrier islands goes back about 250 years. Naturalists William Bartram and Mark Catesby detailed various flora and fauna on islands near Charleston and Savannah, Georgia, in books published in the 1700s. And on November 10, 1831, John J. Audubon spent time on Cole's Island, which overlooked a sand bank very near where Bird Key Stono meanders today. He focused on long-billed curlews that flocked to the area, and initial sketches that day contributed to the curlew illustration in his landmark work, *The Birds of America*.

"They flew directly towards their place of rest, called the Bird Banks," Audubon noted in his *Ornithological Biography*, "and were seen to alight without performing any of the evolutions which they exhibit at their feeding places, for they had not been disturbed that season."

Even in 1831, barrier islands and sand banks were ideal for making observations about nature because creatures were undisturbed by humans or other predators. While vacation homes and golf courses have sprouted

on many large barrier islands on the S.C. coast since the 1950s, efforts to build on the state's undeveloped private barrier islands have slowed in recent years. Development plans have been floated for Waties Island, Bay Point Island near Beaufort, and Morris Island along the Charleston Harbor.

Most undeveloped barrier islands in South Carolina are publicly owned and protected from development pressures. The University of South Carolina Beaufort controls Pritchards Island, though erosion has forced the evacuation of a former research facility there. The S.C. Department of Parks, Recreation, and Tourism bought St. Phillips Island in 2018, with plans for only minor park development.

North, Sand, South, Cedar, Murphy, Capers, Pockoy, Pine, Otter, and Turtle islands, as well as various sand banks that blink on and off through the years, are managed by SCDNR. The U.S. Fish and Wildlife Service is caretaker of the Cape Romain National Wildlife Refuge islands — Cape, Lighthouse, and Bulls — as well as Raccoon Key.

Much of the land behind them also is protected, allowing for beach retreat. What follows are snapshots of

the work researchers did in these special places along the South Carolina coast in the spring and summer of 2019.

WATIES ISLAND: DETERMINING WIND ENERGY POTENTIAL

About one-third of Waties Island, along with high land on the bluff just inland of the island, was bequeathed to the Coastal Education Foundation, a nonprofit organization affiliated with Coastal Carolina University (CCU), in 1995 by Anne Tilghman Boyce. The rest of the northernmost barrier island in South Carolina is privately owned, but none of the island is developed now.

For more than two decades, CCU has utilized the island for class field trips and research on topics such as native archaeology, beach erosion, and salt marsh ecology. Professors and students unlock the gate and drive over a short bridge into a world dominated by nature.

Waties, with about 520 acres that stays dry during an average high tide, features a wide natural dune field. Paul Gayes, director of CCU's Burroughs and Chapin Center for Marine and



GAUGING GUSTS. A sonic detection and ranging device tucked behind the dunes on Waties Island measures wind velocity at elevations above 400 feet, and the findings open new possibilities for wind energy production in coastal South Carolina.

PHOTO/JOEY HOLLEMAN/S.C. SEA GRANT CONSORTIUM

Wetland Studies, likes to take first-time visitors to the dunes at the north end of the island for the dramatic view of an undeveloped barrier island immediately juxtaposed with the tourism-based infrastructure of the rest of the Grand Strand. “I find that backdrop really changes the nature of a range of environmental discussions related to policy and land use,” Gayes says.

Some of those future conversations will revolve around one line of research being done on the island. CCU, as the lead university for the U.S. Department of Energy’s Southeastern Wind Resource Center, placed a sonic detection and ranging (SODAR) device just behind the first line of dunes at Waties in 2015. About the size of a subcompact car, the device might go unnoticed beside a North Myrtle Beach hotel, but its metal body and reflective solar panels stand out in the sand dunes and sea oats of Waties.

While researchers at CCU have been looking into offshore wind energy potential for years, the study of wind potential over land in the region is relatively new. At the height turbine towers were built in the past, the wind over land in the S.C. coastal plain is

too weak and inconsistent for efficient power production, Gayes says. But new technology allows for taller turbine towers, and researchers want to determine if the winds are stronger up in the 400 to 525-foot range. The SODAR process measures the effect of atmospheric turbulence on sound waves, and it provides accurate wind-speed readings at much higher elevations than traditional structure-mounted wind gauges.

Over the past three years, the Waties SODAR station collected data which indicate good wind potential up to 650 feet. “This provides a critical vertical profile,” Gayes says. “The measured velocity was better than expected. That means if towers go a little taller, it opens up new possibilities in South Carolina. Two or three years ago, there was no chance; now there is potential.”

NORTH ISLAND: ERADICATION OF A NON-NATIVE SPECIES

North Island in Georgetown County ranks among the most wild of South Carolina’s barrier islands. Northern philanthropist Thomas Yawkey bequeathed the land to what is now the SCDNR in 1976, and his will

put strict stipulations on the island’s management as part of the Tom Yawkey Wildlife Center (YWC). Basically, he wanted nature to have its way on North Island with as little human impact as possible. Much of the 4,400-acre island is heavily forested, with dense undergrowth interrupted by majestic live oaks.

Geography has been kind to the island, with replenishing sediment washing down five rivers into Winyah Bay and North Inlet and longshore ocean currents creating minimal erosion. Thus the island’s nine miles of beach have remained relatively stable as time and tide have allowed the buildup of one of the largest dune fields in the state, sometimes more than 110 yards wide.

In recent years, non-native feral hogs trekked down from the dense forests to the wide beaches to find an abundant food source – the eggs of loggerhead sea turtles. A survey in 2010 found 25 of 26 sea turtle nests sampled on the island had been destroyed by feral hogs. Property managers decided to take action against the hogs in favor of turtles that have nested on coastal islands for centuries.

The effort turned into a research project that examined how best to get rid of feral hogs, the impact of falling hog populations on turtle egg depredation, genetic links between island hogs and those on the nearby mainland, and the economic return for removing hogs from the island. The results were published in the journal *Acta Oecologica* in June 2019.

Staff from YWC and the U.S. Department of Agriculture Wildlife Services Division threw every resource at the hogs. Trapping and public hunts removed 243 hogs in six years, and sharpshooters were more effective after the population fell to 11 in 2013. The last remaining hog was killed by a sharpshooter at a sea turtle nest in 2016. No hogs have shown up on trail cameras since then, says Jamie Dozier, the SCDNR wildlife biologist who manages the property.

Research findings give hope they



PHOTO EVIDENCE. A game camera caught this non-native feral hog in the act of destroying a loggerhead turtle nest on North Island before managers rid the island of feral hogs.

PHOTO/TOM YAWKEY WILDLIFE CENTER



NEST INVENTORY. Clemson University's Thomas Rainwater marks an alligator egg before handing it to undergraduate intern Maggie Priore, as graduate assistant Randeep Singh jots down details.

PHOTO/JOEY HOLLEMAN/S.C. SEA GRANT CONSORTIUM

won't return. Genetic testing of the island and mainland hog populations found they were from distinct lines. In other words, the hogs on the island almost certainly didn't swim there from the mainland but were brought by boats from other areas, likely as prey for hunters.

As the hog population fell, depredation of turtle nests dropped remarkably: 138 of 158 nests on the island were destroyed by hogs in 2011, but only five were damaged over the next three years. Researchers speculate the hogs conditioned to feeding at turtle nests were among those removed early in the project. When some of the few hogs remaining in 2015 discovered this easy food source, however, nest damage skyrocketed to 75 that year.

The total number of hatchlings lost to hog predation from 2010-2017 was estimated at 19,406. Researchers used a value of \$100 per hatchling, based on the minimum civil fine in coastal states for people who take eggs from nests. (Florida's statute calls for a \$100 fine per egg. South Carolina has a minimum fine of \$1,000.) Using the more conservative value still adds up to an estimated value of \$1,940,600 for hatchlings lost to hog depredation, which makes the \$189,880 spent on the hog eradication effort a bargain, according to the research.

As an undeveloped barrier island with no road access, North Island proves both ideal and challenging for the research work. Equipment and people have to arrive by boat, and

larger equipment has to be off-loaded onto the beach.

"It could often take an entire day to do a simple task like monitor and rebait a trap," Dozier says.

But the seclusion also helps. "The risk of impacting people or pets with the removal efforts was minimal," Dozier says. "The feral hogs also were potentially not as wary of human activity due to having little interaction with people."

SOUTH ISLAND: STUDYING ALLIGATORS OVER THE DECADES

The logistics of research are less difficult on the other islands that make up the YWC. Though researchers have to take a short ferry ride over the



KEEPING WATCH. *Thomas Rainwater returns a camera to its stand after replacing the memory card. The images captured by the cameras track how often mother alligators return to their nests.*

PHOTO/JOEY HOLLEMAN/S.C. SEA GRANT CONSORTIUM

Intracoastal Waterway, at least they can drive vehicles on the rutted dirt roads of South Island. Researchers flock to the mostly undeveloped property for projects that in recent years investigated soil chemistry related to prescribed burns, the geological development of spit islands, and breeding or migration patterns of semipalmated sandpipers, Wilson's plovers, and MacGillivray's seaside sparrows.

However, the most storied work at YWC deals with alligators. SCDNR biologist Phil Wilkinson began trapping and marking gators on the

property 40 years ago. Some of those original marked gators are still around, while new resident gators have moved in and also have been captured and tagged. Wilkinson long ago retired, but he still goes up in a helicopter routinely to spot nests. When not in the air, he joins the research team at YWC to share his wealth of knowledge on the local alligator population. "After 40 years, you get to know each other," he says, speaking of the alligators, not the people.

Routine recaptures of the long-term resident alligators prime research

on growth, reproduction, survival, nesting ecology, population genetics, and exposure and response to environmental contaminants.

Thomas Rainwater, a Clemson University scientist who serves as the YWC's wildlife research coordinator, has worked alongside Wilkinson on the alligator project since 2010. He says research there debunks theories on alligator growth (it eventually stops when they reach middle age in their 30s or 40s) and female reproductive years (which continue as they reach ages of 60 or more). New projects this year focus on microplastics in alligator scat, the influence of climate (air temperature) on nest temperature and the resulting sex and health of hatchlings, and what factors determine how often and for how long female gators visit their nests after depositing eggs.

To gather nest data, Rainwater heads out five or six days a week from early June through early July, the peak nesting season for alligators. This year, graduate student Randee Singh and undergraduate intern Maggie Priore join him.

They load up on bug repellent, then hack through maritime forests, wade through marsh grass, or paddle a canoe to islands in freshwater ponds to get to nests Wilkinson spotted earlier from the air. Female alligators thrash about to mash down vegetation – mostly marsh grass – in nest areas about 20 feet in circumference. They look like small crop circles from the air.

In the middle of the openings, the gators push up a mound of debris into a nest, lay eggs, and bury the eggs in the nest mound. The research team comes in later and measures the size of the nesting area and the nest itself, as well as how deep into the nest mound the eggs are buried. They then remove all of the eggs to count them (the average clutch size at YWC is 44). They keep five eggs for DNA testing and carefully return the rest to the nest.

This year, the researchers bury thermistors in some of the nests for a temperature study. Also new this year are mounted game cameras that take

photos of the nest site once every minute. The images are recorded on memory cards, which have to be replaced every six days. The images help determine not only how often female gators return to their nests, but which potential predators, usually raccoons, show up.

Visits to mount cameras, retrieve eggs, and measure nests can take 30 minutes or more, but camera memory card replacement is as quick as getting to the nest and back. Of course, every trip requires caution. Mother gators typically hang out near their nests. Many of the gators at YWC have been captured and released in the past, making them wary of human encounters. But several times a year, a gator

chases researchers away from a nest.

The most dangerous part of gator research involves capturing adults. Rainwater says he had one close call years ago when a gator clamped down on his hand and quickly let go. For 2019, however, none of the research projects require gator captures. Team members joke that their biggest fears involve the pterodactyl-sized mosquitos.

According to Rainwater, the YWC islands are ideal for gator research because the management of former rice fields and other impounded wetlands allows for habitats with varied salinity. It's also critical that no alligator hunting has been allowed on the property for more than 100 years,

and that alligators have been studied there extensively for 40 years. "There's nowhere else with such long-term data on individual alligators," Rainwater says. "We catch animals that Phil first caught in the late 1970s and early 1980s when they were already adults. That's how we can show that they stop growing at some point. And now we can check DNA to see if some of the eggs are connected to females that are 60 to 70 years old."

CAPE ISLAND: CHECKING ON (LOTS OF) TURTLE RETURNS

Cape Island juts out from the South Carolina coast like a prominent chin, daring bully storm waves to



DELICATE OPERATION. Sarah Dawsey, director of Cape Romain National Wildlife Refuge, and volunteer Donnie Lane gently remove loggerhead turtle eggs from a nest that needed to be moved to higher ground on Cape Island.

PHOTO/JOEY HOLLEMAN/S.C. SEA GRANT CONSORTIUM

punch it. And they do, so often and with such force during recent hurricanes that what once was one long island is now three, separated by newly created inlets. The middle section is more of a new sand bank than a new barrier island. And the southernmost of the three has latched onto the marsh at the north end of Lighthouse Island, making a mockery of even recent maps.

But no matter how difficult the islands of the Cape Romain National Wildlife Refuge are to pin down, female sea turtles manage to find them and deposit eggs in their sand more often than anyplace else in the state,

according to the SCDNR S.C. Marine Turtle Conservation Program. Nest data indicate an average of 1,400 nests were located each year on Cape and Lighthouse islands in the decade from 2009-2018. Then 2019 broke all records, with 3,373 nests on the two islands by the end of August. The vast majority are loggerhead turtle nests.

Sea turtles seem to appreciate the islands' prominence and privacy. Amid the vacation-goers several islands to the south on Folly Beach, a 100-nest season is considered extraordinary.

No wonder Sarah Dawsey, the Cape Romain refuge director, looks exhausted near the end of a day of

turtle nest research in late June. Her typical nest-checking day starts at 6 a.m. at a refuge facility in Awendaw, with a short drive to a boat launch in McClellanville, and a gorgeous boat ride through the salt marsh creeks to a dock at a small upland area tacked onto the back of Cape Island's four-mile stretch of sandy beach.

Dawsey and stalwart volunteer Donnie Lane ride an ATV filled with gear from one end of the beach to the other, stopping every time they spot new sea turtle tracks in the sand. On this day, they find 35 nests and check out many more false crawls, left when the turtles come ashore but decide not to deposit eggs.

At each nest site, Dawsey plunges a metal probe into the sand until she feels the telltale change in density that indicates a nest. Then either Dawsey or Lane digs carefully by hand, down 12 to 18 inches, until they hit eggs. If the nest is in a precarious location, the eggs are removed, counted, placed in a bucket, and relocated to higher ground. If the nest location seems safe from extreme tides, it is left *in situ*.

Researchers have compiled an inventory of nests and locations since the 1970s. Since 2010, University of Georgia researchers have partnered with natural resource agencies in Georgia, North Carolina, and South Carolina to gather DNA samples from each nest found. By the start of the 2019 season, the genetic database had identified 10,852 individual female loggerheads at more than 68,500 nests.

The goal is to get a better handle on how many different females are nesting in the region each year, how many clutches of eggs each nesting female lays, and if they lay eggs on multiple beaches in the same year.

Most nests have more than 100 eggs, about the size of a pingpong ball, with slightly pliable shells. To obtain a genetic fingerprint, Dawsey and Lane take one egg from each nest. A hole is poked in the shell, the yolk and albumen are squeezed out, and the shell is inserted into a test tube with alcohol to preserve it. Each nest is



RESEARCH READY. A brown pelican on Deveau Bank takes flight equipped with a GPS transmitter backpack that will allow scientists to track its movement.

PHOTO/GRACE BEAHM ALFORD

given a number, which Dawsey marks down in a ledger along with GPS coordinates.

Despite punching the probe into the ground hundreds of times, digging down to dozens of nests, and digging new holes for 11 relocated nests, Dawsey smiles through the exhaustion after more than six hours at the beach on a hot summer day. “The DNA testing shows there are three different generations nesting out here,” she says. “They don’t nest until they’re 30 years old, so there’s a 90-year-old grandma nesting out here!”

DEVEAUX BANK: GAUGING URBAN IMPACT ON PELICAN NESTING

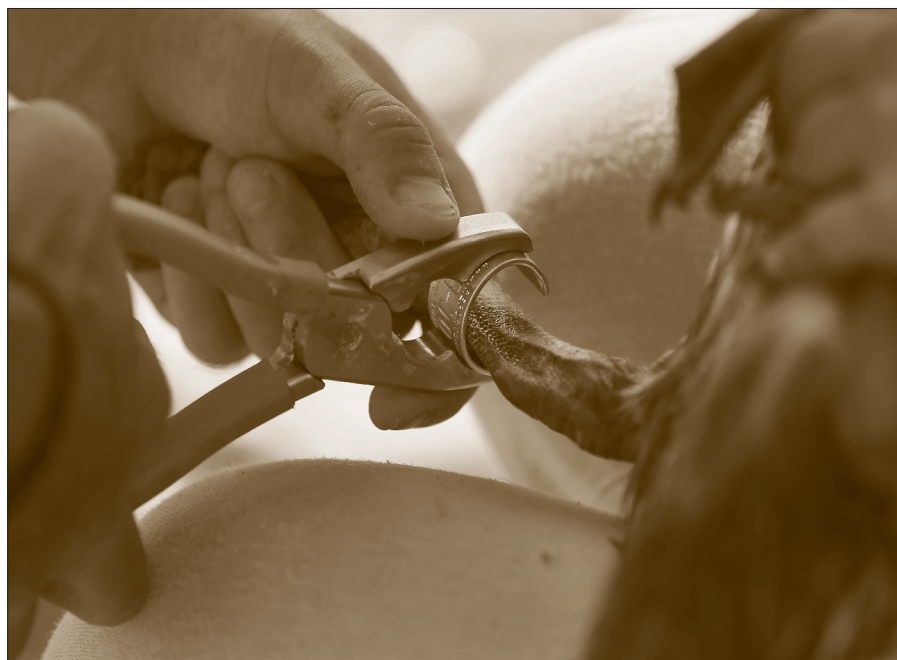
As a boat carves out of Bohicket Creek into the North Edisto River, Deveaux Bank appears on the horizon as nothing more than a sand bar with minimal green growth. When the boat nears the bank, that assumption proves way off base. The island teems with bird life – on this morning dominated by loud laughing gulls, royal terns, and brown pelicans.

Surrounded by channels of swift-moving water and lacking maritime forest uplands and attached marshes, sand banks remain free of the predatory mammals of classic barrier islands. Birds, probably for that reason, flock to sand banks.

“It’s a special place,” says Clemson University doctoral student Bradley Wilkinson, who rotates his summer 2019 research days among the rich seabird nesting areas on Deveaux Bank, Bird Key Stono, and Castle Pinckney.

Wilkinson works under Clemson’s Patrick Jodice on a S.C. Cooperative Fish and Wildlife Research Unit project. On a stiflingly hot and windless July morning, Wilkinson and his assistant, Wake Forest University undergrad Landis Pujol, set out to tag several brown pelicans on Deveaux Bank.

Finding pelicans on the bank is easy. After only about 20 of the birds nested there in 2017, the nesting



ID BRACELET. Researchers take feather and blood samples and place identifying bands on the brown pelicans captured for the movement study.

PHOTO/GRACE BEAHM ALFORD

numbers grew to between 200 and 300 in 2018 and more than 2,000 in 2019. Pelicans vary their nesting sites from year to year, and Deveaux Bank was the popular choice along the S.C. coast in 2019, Wilkinson says.

To start the banding process, Wilkinson creeps up on the nesting site carrying a pole with a loop on the end. He crouches for several minutes, waiting for the best opportunity to slip the loop over an adult pelican. When Wilkinson finally latches onto a bird, Pujol races out with a cloth bag to put over the bird’s head and keep it as calm as possible during the banding and examination.

The bird is weighed, then Wilkinson attaches a metal band to one leg and a plastic band to the other leg. Ribbons wrapped under the wings pass through a miniature GPS tracking device, making it look like the bird is wearing a small backpack. Along the way a feather sample is clipped, a blood sample taken, wing and tarsal measurements collected, and all of the data written in a notebook.

After less than 15 minutes, the pelican is set free, flapping its wings a few times on land before skimming

gracefully over the water. Jodice is one of the authors of a 2016 study that found pelicans captured and fitted with transmitters, after a day or two of adjustment, breed and behave similarly to others in their nesting community that haven’t been captured.

The bird Wilkinson snags is the 52nd pelican to be equipped with a transmitter for this project from 2017-2019. The field season is nearing a close because Wilkinson has only eight more transmitters.

Brown pelicans are a wildlife management success story. Once considered endangered, largely because of the impact of pesticides such as DDT on egg shells, the species rebounded once those pesticides were banned. It was removed from the endangered list in 2009. Jodice assumed such a high-profile species had been thoroughly studied, but he found slim information on its migratory and foraging patterns. Tagged birds are filling those knowledge gaps.

“Whenever we put tags on birds, we never say ‘Hey, look! They’re doing exactly what we thought they’d do,’” Jodice says.

For instance, transmitter data

indicate pelicans fly much farther away from their nests to forage than previously suspected. Jodice says that information can help inform questions about development in marine ecosystems.

"We've been able to add a lot of detail about migration movements, how they get here and how long it takes," Jodice says. "You can't understand potential conservation issues if you don't understand that trip."

BARRIER ISLANDS FORM, AGE IN MULTIPLE WAYS

The most elemental research on barrier islands focuses on their geography. They form in three ways:

- when a new inlet cuts off a spit at the end of an island, as the south end of Cape Island did before attaching to Lighthouse Island,
- when offshore sandbars build up and vegetation takes hold, as at Sand Island, or
- when former high ground is drowned, either through erosion or

rising sea levels.

Pockoy Island at Botany Bay Heritage Preserve provides a modern example of the formation of barrier islands through inundation of higher ground. Fifty years ago, Pockoy was a hummock island waystation on a long, man-made causeway out to a barrier island known as Botany Bay Island. As Botany Bay Island succumbed to erosion, the sand that marked its beach retreated to Pockoy.

Digitized maps indicate the shoreline moved 1,640 feet from 1949 through 2016, according to Katie Luciano, a coastal geologist with the SCDNR. That's 24.5 feet per year, before rising sea levels combined with multiple hurricanes to eat away another 150 feet of the central beach from Pockoy in 2016 and 2017. "This is coastal geology in action," Luciano says.

The recent erosion threatens a shell ring created 4,300 years ago by the region's early inhabitants. In May 2017, two branches of research combined as archaeologists working on

the shell mounds helped Luciano and College of Charleston (CofC) geologist Scott Harris collect a vibracore sample nearby. Vibracoring utilizes high-frequency, low-amplitude vibrations to drive a core tube into the ground. They also collected samples on what might be a dune ridge on the back of Pockoy, and another on a hummock island behind Pockoy.

The resulting tubes packed with sediment layers are pulled up and taken back to the CofC, where three months later Luciano and Harris cut them open. Even to the untrained eye, the point where sandy sediment runs into thick, dark mud stands out. Luciano and Harris quickly cover that section of the sample, and the deepest section of sand will be shipped off for dating through optically stimulated luminescence (OSL). The OSL process can determine the last time the quartz in beach sand was exposed to light, thus determining when a layer of a core sample was a beach.

Harris has been gathering samples throughout the coastal region for decades, and OSL results are fascinating. For instance, OSL dating indicates Folly Island has been front beach for 500 to 2,000 years. The hummock island just behind Folly, Long Island, was front beach about 2,000 years ago. The next ridge of hummock islands that includes Goat Island was front beach 6,000-8,000 years ago. And the ridge just behind Goat Island that includes Sol Legare Road was beach about 82,000 years ago.

These dates drive home the reality that coastal islands in general and barrier islands in particular constantly change. To get a better handle on the how and why, researchers study the current islands' sediment budget, checking upper level sediment to determine where it came from, how long it stays, and where it goes. They can tell whether the sediment washes down from inland rivers or is dragged along by currents just offshore.

But humans make those determinations more difficult by controlling sediment flow down rivers with dams,



ANCIENT SHORE. Special testing of the section of a soil core sample where dark mud turns to sand provides answers to when the location featured an active beach.

PHOTO/GRACE BEAHM ALFORD



HEADING HOME. Researcher Bradley Wilkinson and assistant Landis Pujol head back to their boat after the summer heat cut short a brown pelican tagging trip on Deveau Bank.
PHOTO/GRACE BEAHM ALFORD

blocking offshore drift with jetties, and using sand from deposits far offshore to renourish beaches. The best places to study those processes in South Carolina are the string of undeveloped beaches from North Island through Capers Island. The

rivers that flow into Winyah Bay aren't dammed anywhere in South Carolina, and none of those beaches are developed or renourished.

"In order to understand what we've done on inhabited barrier islands, we have to go to the

uninhabited ones," Harris says. "They show a true natural system in action."

Whether studying geology, wind energy, wild hogs, alligators, sea turtles, or brown pelicans, that most natural of environments is what lures scientists to the undeveloped islands. ♡



Reading and Websites



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NEWS & NOTES

Teachers train for From Seeds to Shoreline®

Like a class of freshmen full of anticipation but not exactly sure what they have gotten themselves into, 15 educators gathered in Charleston on July 31, 2019 for a one-day training session for teachers new to the From Seeds to Shoreline® program.

From Seeds to Shoreline (S2S) is a salt marsh restoration program that introduces K-12 students to a critical coastal ecosystem through gathering the seeds of smooth cordgrass, (*Sporobolus alterniflorus*), cultivating them in school-based greenhouses, and planting them in select marsh locations.

Those who gathered for the 2019 new teacher training session work with a range of K-12 students.

E.V. Bell, S.C. Sea Grant Consortium marine education specialist, told the newcomers the goals for the day were to help them appreciate the importance of the salt marsh

ecosystem, indoctrinate them in S2S's history and purpose, and provide resources to empower them to bring the program to their schools.

For homework, the participants were each assigned either a salt marsh plant or animal and asked to bring in a "fun fact" on that creature. Once on site, they headed out into the marsh for a brief introduction to the star of the program, *S. alterniflorus*. Then they were tasked with finding an example of their homework assignment in the marsh.

The teachers found marsh grass, fiddler crabs, periwinkle snails, sea pickle, and sea ox-eye daisies. Then they gathered to share tidbits of knowledge about these salt marsh residents.

As the day moved on, the teachers learned how to recognize when the *S. alterniflorus* seeds are ready to be harvested, how to slide pinched fingers up the stalk to pry away the seeds, and how and where to store the seeds during germination. Michael Hodges, a marine biologist with S.C. Department of Natural Resources (SCDNR) South Carolina Oyster Restoration and Enhancement program, walked them through the process of cultivating the seedlings in small containers of soil, and he stressed the importance of keeping them moist. "It's all about keeping the babies alive," he said.

The teachers practiced constructing one of the small, prefabricated greenhouses used to

protect the seedlings through the winter months. Then they headed back out to a designated marsh restoration area for a demonstration of the planting process, which involves assigning hula hoop-sized areas to students and providing trowels to dig small holes for the seedlings.

The S.C. Sea Grant Consortium launched the S2S program in 2011 in partnership with SCDNR and Clemson University Cooperative Extension. Teachers in more than 50 schools throughout South Carolina have participated in the program, and companion efforts have launched in North Carolina and Georgia. In addition to educating students, the program is designed to restore degraded marsh areas. During the 2017-18 school year, 28,182 stalks of *S. alterniflorus* were planted by 1,274 students, creating 1,888 linear feet of restored marsh. ✓

S.C. scientists earn Sea Grant aquaculture funds

Three projects with direct South Carolina connections were among 42 research proposals selected to receive \$16 million in federal funding aimed at advancing sustainable aquaculture in the United States.

The National Sea Grant College Program sought aquaculture proposals that encourage collaboration, explore new opportunities, or address critical gaps in knowledge. Because wild-caught seafood cannot meet the rising global demand, the National Oceanic and Atmospheric Administration and its Sea Grant partners have committed to advance U.S. aquaculture in informed, sustainable, and properly



Educators learn the Restoration Day routine for the From Seeds to Shoreline program.

PHOTO/JOEY HOLLEMAN/S.C. SEA GRANT CONSORTIUM

NEWS & NOTES

regulated ways.

Many of the three-year projects, which require a 50 percent local match, cut across state and regional boundaries. The selected projects directly related to South Carolina include:

- A S.C. Sea Grant Consortium study by Clemson University's Mark Blenner on the potential for renewable agricultural products and wastes, such as animal fats and plant oils, as sustainable feedstocks for aquaculture operations. (\$100,000)
- An effort to expand comprehensive training opportunities for shellfish growers in Georgia, South Carolina, and North Carolina, including classroom and field work. While N.C. Sea Grant is the lead applicant, S.C. Sea Grant Consortium is one of the partners. (\$95,500)
- An effort to help the managers of shellfish hatcheries, nurseries, and farms understand the basics of disease risks to prevent the potential spread of disease, and to develop a structure for regulators to develop a seed database and a hatchery certification program. S.C. Department of Natural Resources is among the partners in the project. (\$1.17 million) ✓

Event makes flood resilience family-friendly

Talking about sea-level rise and tidal flooding might seem an odd fit for a child-oriented event, but risk communicators need to reach out to varied audiences. That's why a group from S.C. Sea Grant Consortium, Carolinas Integrated Sciences and Assessments,

and the College of Charleston's Lowcountry Hazards Center and Office of Sustainability set up tables at the Folly Beach Family Fun Night on July 9, 2019.

Many of these same groups were involved at community events over the past year in North Charleston and Mount Pleasant. Those events, however, focused entirely on spreading the word about flood resilience; at this event, the group shared space at Folly River Park with weekly Family Fun Night features like face-painters, hula hoops, and a photo booth.

The unusual setting seemed appropriate for the City of Folly Beach, a much smaller community than North Charleston or Mount Pleasant. The Consortium has been working with Folly Beach on a number of flood resilience issues, many of which have been discussed at city council and planning commission meetings.

"We were trying to reach people who don't come to meetings," said Sarah Watson, the Consortium's coastal climate and resilience specialist. "At an event like this, the people are already there. You just bring them over and help them connect."

Parents and grandparents who stopped by tables at Folly Beach compared the flood map information with actual flooding from recent events on their property.

Meanwhile, the children who accompanied them were kept busy with activities designed to enlighten but not frighten. They drew pictures of creatures that live in and out of the water at the ocean's edge, checked out how water flowed under and around a Lego® building, and learned how the moon causes King Tides that often lead to temporary road flooding on Folly Beach. ✓

Gorstein joins Consortium as economics specialist

Matt Gorstein has joined the S.C. Sea Grant Consortium staff as a coastal economics program specialist, a new position created to provide applied economic research and outreach for the agency's many constituencies.



MATT GORSTEIN
PHOTO/SUSAN FERRIS
HILL/S.C. SEA GRANT
CONSORTIUM

Gorstein will work independently and with applied economics professionals at the Consortium's member institutions to analyze the value of the state's coastal and marine resources as well as the value of the Consortium's work. He will share that information with coastal communities, organizations, and businesses.

Gorstein has a bachelor's of science in economics and a master of science in food and resource economics, both from the University of Florida. Before joining the Consortium, he worked as a natural resource economist with the National Oceanic and Atmospheric Administration's National Centers for Coastal Ocean Science in Charleston. He has analyzed the costs and benefits of shoreline infrastructure projects; the storm damage reduction value of wetlands; the demographics of seafood customers and their demand for fresh products; and the knowledge, attitudes, and perceptions of coastal communities. ✓



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EBBS & FLOWS

North Carolina Coastal Conference

*Wilmington, North Carolina
November 19-20, 2019*

Join North Carolina Sea Grant and its researchers and partners to discuss a range of critical issues, including climate, community and ecosystem health, fisheries and aquaculture, economics, and planning. The goal is to improve efforts to respond to, recover from, and anticipate coastal challenges. Visit ncseagrant.ncsu.edu/nc-coastal-conference-2 for more information.

American Geophysical Union Fall Meeting

*San Francisco, California
December 9-13, 2019*

The American Geophysical Union meeting delves into new data streams, changing approaches to observing our Earth and beyond, and the growing demand for accessible science. The long-term goal is for Earth and space science research to make our planet safer, cleaner, and more sustainable. For more information, visit www.agu.org/Fall-Meeting.

Social Coast Forum

*Charleston, South Carolina
February 3-6, 2020*

Participants from academia, government agencies, and the private sector share how social science tools and methods are used to address the nation's coastal issues, such as climate change and land-use planning. Understanding where people live, what they do, and what they value is critical to coastal management. Visit coast.noaa.gov/digitalcoast/contributing-partners/news/social-coast-forum-2020.html for more information.

Subscriptions are free upon request by contacting: Joey.Holleman@scseagrant.org

ATTENTION SCHOOL TEACHERS! The S.C. Sea Grant Consortium has designed supplemental classroom resources for this and past issues of *Coastal Heritage* magazine. *Coastal Heritage Curriculum Connection*, written for K-12 educators and their students, is aligned with the South Carolina state standards for the appropriate grade levels. Includes standards-based inquiry questions to lead students through explorations of the topic discussed. *Curriculum Connection* is available online at www.scseagrant.org/coastal-heritage-curriculum-connection.

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